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ABSTRACT

Synthesis methods used to produce poly(2-methoxyaniline-5-sulfonic acid) (PMAS), a water soluble, self-doped conducting polymer, have been shown to form two distinctly different polymer fractions with molecular weights of approximately 2 kDa and 8 –10 kDa. The low molecular weight (LMWT) PMAS fraction is redox inactive and non-conducting while the high molecular weight (HMWT) PMAS is electro-active with electrical conductivities of 0.94 ±0.05 S cm^{-1}. Previous investigations have illustrated the different photochemical and electrochemical properties of these fractions, but have not correlated these properties with the structural and electronic interactions that drive them. Incomplete purification of the PMAS mixture, typically via bag dialysis, has been shown to result in a mixture of approximately 50:50 HMWT:LMWT PMAS with electrical conductivity significantly lower at approximately 0.10 to 0.26 S cm^{-1}. The difference between the electrical conductivities of these fractions has been investigated by the controlled addition of the non-conducting LMWT PMAS fraction into the HMWT PMAS composite film with the subsequent electronic properties investigated by solid-state ESR and Raman spectroscopies. These studies illustrate strong electronic intereactions of the insulating LMWT PMAS with the emeraldine salt HMWT PMAS to substantially alter the population of the electronic charge carriers in the conducting polymer. ESR studies on these mixtures, when compared to HMWT PMAS, exhibited a lower level of electron spin in the presence of LMWT PMAS indicative of the the formation of low spin bipolarons without a change the oxidation state of the conducting HMWT fraction.